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MICRONAIRE BLENDING OF MEDIUM-STAPLE COTTONS--

AN ECONOMIC EVALUATION

U.S. DEPARTMENT OF AGRICULTURE • ECON

ABSTRACT

This report compares the performance of blended Micronaire mixes of cotton with that of natural mixes of the same average reading to determine the economic feasibility of using cottons "discounted" in price for high- or low-Micronaire readings. Cottons ranging from 3.2 to 5.2 in Micronaire were selected from the 1968-69 crop and spun into 40s carded yarn. Twenty-three mixes were spun--five natural Micronaire mixes and 18 blended. In addition to the test results, the report demonstrates a method of potential usefulness to commercial mills for determining appropriate price discounts for cottons of high- or low-Micronaire readings.

Key Words: Cotton, Micronaire reading, Blend, Price, Discount, Manufacturing cost, Quality.

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SUMMARY

Blending of discount cottons with cottons in the mid-range of Micronaire readings appears to be economically feasible, although there is a tendency for the price discount to the manufacturer to be offset by lower processing performance.

The evaluation implies that use of more than 5 percent cotton with Micronaire levels as low as 3.2 probably would produce both processing and quality problems, including dyeing problems. However, cotton with 5.2 Micronaire level could range up to about one-third of the mix without serious processing and quality problems. Higher proportions of high-Micronaire cotton would probably produce both higher end breakage and loss of yarn quality, particularly yarn strength.

The test results of evaluating natural cotton and blended mixes on the basis of spinning, finishing, and dyeing performance showed the 3.7 Micronaire mix to be the best of the natural mixes, followed by 4.2. Other natural mixes did not compare favorably with these two. The 3.2 mix was particularly low in processing performance and yarn quality, owing to a combination of low Micronaire, low-fiber length uniformity, and low-fiber strength.

Among the blended mixes, only one was entirely satisfactory in performance, compared with the 3.7 natural Micronaire mix. It contained 41 percent 5.2 Micronaire cotton but no 3.2 cotton. No dyeing problems were encountered with this mix. The raw cotton cost of this mix was discounted at 0.26 cent per pound. Three additional mill-type mixes were satisfactory in performance, compared with the natural 4.2 Micronaire mix, and were discounted in price by about 0.1 to 0.2 cent per pound. The primary purpose of the estimated price discounts is to demonstrate a method of calculation, since costs and product values vary among mills.

Test results show the only significant effects of greater spindle speed to be increased levels of spinning and breakage and slightly decreased levels of yarn break factor.

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by

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INTRODUCTION

In current marketing practices, substantial discounts are levied against cottons with Micronaire readings outside the range 3.5 to 4.9. In commercial use, small percentages of these discounted cottons are generally blended with cottons toward the center of the range of Micronaire readings to form a mill mix. Use of small percentages of high- or low-Micronaire cottons to make up a mill mix has thus proved satisfactory. Combining this information with the knowledge that any given bale of raw cotton has a wide range of Micronaire among its individual fibers naturally leads to the question of whether larger percentages of high- and low-Micronaire cottons might be blended into a mix without serious detrimental effects on either performance or product quality. The economic incentive to do so is substantial. For example, in the current season, a savings of 2.47 cents per pound of raw cotton could be realized by blending 31 pounds of cotton with a 2.5-Micronaire reading with 69 pounds of cotton with a 5.5-Micronaire reading to get 100 pounds of cotton averaging 4.0 in Micronaire reading. 2/

Objectives

In response to the apparent need for an evaluation of Micronaire blending, this study was conducted in 1968-69 to complement and extend findings of earlier Micronaire studies--particularly with respect to the feasibility of blending. It was designed to provide information on the relative use values of cotton with different Micronaire levels. The objective was to compare performances of various Micronaire levels and distribution--specifically, the performance of various blends averaging 3.7, 4.2, and 4.7.

Relative spinnability and quality of greige and dyed goods are major concerns in this type of study. Accordingly, the effects of various levels and combinations of Micronaire readings on finishing and dyeing properties were of prime interest in this test.

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2/ Weighted average discount based on average discounts in 12 markets, August 1970.

The results of this study should be useful in establishing realistic price differentials and in providing guidance on economical use of raw cotton in mills.

Other Studies

Numerous studies have been made to determine the effects of varying the levels of Micronaire. Although a complete literature review was not possible, some published works of the past 20 years are cited to provide background information on the effects of varying Micronaire levels (see References). One study (3), conducted in the Pilot Spinning Laboratory during 1964, concluded that decreasing Micronaire levels, ranging from 5.5 to 3.3, resulted in the following significant changes in performance during processing into 30s or 40s carded yarn:

(1) Decreased levels of spinning end breakage
(2) Increased levels of break factor
(3) Decreased levels of yarn appearance.

None of the studies cited in the References were designed to compare blends of various Micronaire levels. In 1965, a study of Micronaire blending was made at the Pilot Spinning Laboratory. Cottons of various Micronaire levels in the 3.3 to 5.5 range were blended to average Micronaire levels of 4.2, 4.5, and 5.0, and compared with cottons of natural Micronaire levels of the same respective readings. Cottons within any natural Micronaire group were not preblended before processing. Although an attempt was made in selecting cottons to hold constant all fiber properties other than Micronaire, these properties varied sufficiently to mask any effects of Micronaire levels which may have been present. This problem, owing to one replication of the study spinning differently from the other two, precluded a formal publication of the results. These problems might have been alleviated to some extent if the cottons had been preblended in each natural Micronaire group before processing. Experience gained in conducting the 1965 study--which was unpublished--however, was the basis for the planning of this study.

More recently, an extensive study was made of blending various Micronaire levels of short staple cottons--cottons of 15/16 and 1-inch staple spun into coarse yarns sizing 12s and 20s, respectively (5). The objective was to determine the feasibility of blending various combinations of high- and low-Micronaire cotton under a variety of processing conditions. The study concluded that blends of high- and low-Micronaire cottons can result in spinning performance at levels equal to cottons in the 3.5 to 4.9 Micronaire range. Consequently, a blending of discount cottons (with Micronaire readings outside the 3.5-4.9 range) in controlled proportions to achieve average Micronaire levels of 3.8 to 4.2 was recommended. No finishing and dyeing tests were reported in the cited analysis.

Results of a 1971 study indicate that substantial savings are possible from blending of medium-staple (0.99 to 1.03 inch, 2.5-percent span lengths) cottons discounted for Micronaire reading and used in the production of sheeting

(21s warp and 23s filling yarns) (2). Although processing efficiency and yarn quality decreased somewhat, the fabrics made from blends were "marketable without price penalty," using normal marketability criteria.

PROCEDURES

Selection and Blending of Cottons

Forty-one bales of cotton were obtained commercially from producers and mill buyers. In view of the problems of fiber quality variations encountered in the 1965 Micronaire blending study, these cottons were selected very carefully. Efforts were made to keep each fiber property, other than the Micronaire reading, within a very narrow range across the entire test. The grade was largely Strict Low Middling (SLM) and the staple was predominantly 1-3/32 inch for all test cottons. In addition, the cottons were also screened on the basis of instrument measurements: Fibrograph 2.5-percent span length was held at about 1.10 inch, uniformity ratio at about 44-46, and Pressley fiber strength at about 23 grams per tex.

Raw cottons were preblended within each Micronaire group in an effort to further equalize fiber quality. This procedure was a substantial improvement over that used in the previously cited 1965 study. Once the 41 bales were selected, all cottons of a given Micronaire level were preblended by a commercial firm and rebaled before processing through the pilot plant. The number of bales and the corresponding Micronaire level in each preblended group were as follows:

Natural Micronaire level	Number of bales blended
3.2	9
3.7	7
4.2	6
4.7	9
5.2	10

Finally, to obtain 23 mixes for processing, the natural Micronaire cottons were blended as shown in table 1.

Fiber Testing

Samples for fiber testing were drawn from each bale before and after blending. These samples were tested under standard atmospheric conditions (70 degrees Fahrenheit and 65 percent relative humidity) and by standard fiber-testing procedures. After mechanical blending, Digital Fibrograph, Pressley strength, and Micronaire and Causticaire tests were made on the samples. Various chemical tests of fibers were also completed, including differential dyeing to determine fiber maturity.

Table 1.--Cotton: Distribution and level of Micronaire readings, by mix, 1968-69 crop

Mix No.	Percentage of natural Micronaire group					Blended Micronaire level
	3.2	3.7	4.2	4.7	5.2	
	Number					Reading
1	100	--	--	--	--	3.2
2	--	100	--	--	--	3.7
3	--	--	100	--	--	4.2
4	--	--	--	100	--	4.7
5	--	--	--	--	100	5.2
6	43	--	57	--	--	3.7
7	58	--	--	42	--	3.7
8	65	--	--	--	35	3.7
9	17	--	--	--	83	4.7
10	25	--	--	75	--	4.2
11	38	--	--	--	62	4.2
12	--	44	--	56	--	4.2
13	--	59	--	--	41	4.2
14	--	26	--	--	74	4.7
15	--	--	45	--	55	4.7
16	13	21	--	66	--	4.2
17	--	53	--	20	27	4.2
18	--	13	22	--	65	4.7
19	54	--	13	33	--	3.7
20	5	16	50	20	9	4.2
21	51	--	27	22	--	3.7
22	48	--	40	12	--	3.7
23	--	49	--	38	13	4.2

Processing

The 23 blends were then processed into 40s carded yarn, using a low (3.54) twist multiplier. Three spinning lots or reps were spun at three different spindle speeds from each blend for a total of 69 spinning lots.

In the opening room, 750 pounds of cotton were processed as a mix into 14-ounce picker laps. The first five mixes were processed as natural Micronaire, and the remaining 18 as blends with average Micronaire readings of 3.7, 4.2, or 4.7, with different percentages of natural Micronaire used for each blended mix. Each mix was processed identically from opening through roving, but three different spindle speeds were used for each mix. In most cases, these three speeds were the same for each mix, but a few mixes would not spin at the higher spindle speeds.

The processing organization was as follows:

Opening	Two blender feeders One lattice opener
Picker	14-ounce lap, 2-section 1-process picker
Carding	50-grain sliver, 10 pounds per hour
Breaker Drawing	Eight ends up, 50-grain sliver fed, 53-grain sliver delivered
Finished Drawing	Eight ends up, 53-grain sliver fed, 55-grain sliver delivered
Roving	55-grain sliver fed, 1.00 hank-roving delivered, 1.15 twist multiplier
Spinning	1.00 hank-roving fed, 40s carded yarn delivered, 3.54 twist multiplier Variable spinning speed

Roving was creeled singly into four 252-spindle spinning frames equipped with Duo-Roth drafting systems. 3/ New travelers were used for each spinning doff; frames were run for 30 minutes to break in travelers and to obtain yarn for sizing. Draft gears were changed, if necessary, to obtain the specific yarn size, and end breakage was recorded at 15-minute intervals during the spinning of a full doff of yarn.

The card and spinning rooms were kept at 75 degrees Fahrenheit temperature and 50 percent relative humidity throughout the tests.

Yarn Testing

All yarn tests--skein strength, single strand strength, yarn evenness, and yarn appearance--were conducted under standard atmospheric conditions.

Dyeing and Finishing

Several dyeing tests were conducted. The only finishing operations were desizing, alkaline scouring, and peroxide bleaching as preparations for dyeing.

3/ Use of brand names in this report does not constitute endorsement of the product named or imply discrimination against other products.

Various yarns were woven as sections of filling in a filling-face sateen. The fabric was prepared for dyeing by normal wet-processing procedures and was dyed with C.I. Direct Green 26. After dyeing, the fabric sections were evaluated qualitatively for depth of shade and general appearance.

In another test, yarn samples of each natural Micronaire level were dyed in separate dye baths. After the initial dyeing, the yarns were compared and additional dyeings were done using varied concentrations of dye until all yarns matched the median Micronaire (4.2) sample. Differences in concentration of dye required for shade matching were then determined. The matched color yarn samples were scoured in alkaline solution at 50 degrees Centigrade to determine the relative washfastness of the various Micronaire-level yarns. Two dyes--C.I. Direct Red 81 and C.I. Direct Blue 1--were used.

Yarn from each of the natural Micronaire levels was tested for weight loss in wet processing. The treatments consisted of a boiling alkaline scour and a peroxide bleach.

Blending Efficiency

Blending efficiency was checked by comparing the alcohol extractables of blended drawing sliver with that of the individual bales making up the blend. For example, blending equal portions of two cottons, one with 2.5-percent alcohol extractables, and the other with 1.5 percent alcohol extractables, should give a blended cotton with 2.0 percent alcohol extractables. Significant deviation from the calculated alcohol extractables is an indication of poor blending. This procedure indicates large errors in the average blend, but does not show variation in uniformity within the lots, that is, fiber-to-fiber blending efficiency.

Statistical Analyses

For statistical analyses, data were grouped into three Micronaire levels and analyzed separately--seven mixes with a reading of 3.7 Micronaire, nine with 4.2 Micronaire, and five with 4.7 Micronaire. These analyses included both natural and blended mixes. The five natural Micronaire groups were then analyzed as a group to compare performance among these cottons when each constituted 100 percent of the mix. In each case, analysis of variance was the method used to compare treatment means, when treatments were the natural mix and various blends of a given Micronaire level, or the five levels of natural Micronaire. The three replications (blocks) consisted of different spindle speeds. Different spindle speeds were used to estimate some effects of blending Micronaire levels over a wider range of processing conditions, and to obtain supplemental information on the effects of spindle speed on performance and quality of yarn. Because of the difficulty of holding roving for long periods of time, the three reps (spindle speeds) of a mix were spun consecutively. Thus, time of spinning was not blocked in the tests--blocks or reps were synonymous with spindle speed.

To summarize, the four analyses of variance, of randomized complete block design, were of the following types:

Analysis	Number of treatments	Micronaire level
1	7	3.7
2	9	4.2
3	5	4.7
4	5	5 natural mixes

RESULTS

The results of three areas of concern were important in this study. Of primary interest were comparisons of performances of various blends with that of corresponding natural-Micronaire mixes. The fiber quality of cottons making up the mixes must also be considered since the results of such analysis would be meaningful. The third area of interest concerns the effect of varying spindle speeds on the performance and quality of a product. Note that all mixes were spun with a 3.54 twist multiplier.

Quality of the Natural Micronaire Groups

Fiber quality was quite uniform within the five preblended groups of natural Micronaire cotton, except for the 3.2 Micronaire group. Table 2 shows selected fiber data for each natural Micronaire group, averaged across all bales in the group and based on raw stock determinations after commercial blending.

Table 2.--Cotton: Selected fiber data, by natural Micronaire level, blended stock, 1968-69 crop

Natural Micronaire level	Bales blended	Average fiber quality				
		2.5 percent span	Length uniformity	Micronaire level	Pressley 1/	
					1/8" gage	0 gage
Reading	Number	Inch	Ratio	Reading	G/tex	1,000 p.s.i.
3.2	9	1.12	44	3.2	23.1	79
3.7	7	1.12	47	3.7	23.7	83
4.2	6	1.12	48	4.3	22.4	83
4.7	9	1.12	48	4.7	22.9	90
5.2	10	1.11	48	5.2	22.9	91

1/ Based on ginned lint determinations before commercial blending.

These data show that average fiber properties varied considerably among the natural Micronaire groups. In addition to the Micronaire differences purposely built into the test, fiber length uniformity and fiber strength (Pressley 0 gage) tended to increase with greater Micronaire levels, although Pressley

1/8-inch gage fiber strength failed to show this tendency. The 2.5-percent span length was essentially constant across the Micronaire groups.

Among bales within each of the natural Micronaire groups, there was a range of 7,000-9,000 pounds per square inch in fiber strength. The 2.5-percent span length and 1/8-inch gage Pressley (grams per tex) were quite uniform within Micronaire groups.

Additional fiber data for individual bales before preblending are given in Appendix table 1.

In finished drawing sliver, the same general trends in fiber data were prevalent among the five blends spun as natural Micronaire groups (table 3). There was an indication (2.5-percent span length) that fiber breakage during carding and drafting was greater in the 3.2 Micronaire group.

Table 3.--Cotton: Selected fiber data, by natural Micronaire level, finished drawing sliver, average of three reps, 1968-69 crop

Natural Micronaire level	Average fiber quality				
	2.5 percent span	Length uniformity	Micronaire level	Pressley	
				1/8" gage	0 gage
Reading	Inch	Ratio	Reading	G/tex	1,000 p.s.i.
3.2	1.13	47	3.3	21.9	77
3.7	1.15	51	3.7	23.2	82
4.2	1.17	51	4.2	23.5	83
4.7	1.16	50	4.6	23.3	84
5.2	1.15	51	5.0	23.9	87

Fiber test results showed that certain fiber combinations tend to persist across a wide range of Micronaire readings. Fiber strength tended to increase with higher Micronaire levels, and the 3.2 Micronaire group had significantly lower fiber length uniformity than other groups in both raw stock and finished drawing sliver. These variations affected processing results, so their effects had to be considered along with the effects of varying Micronaire levels and distributions.

The 3.2 Micronaire group deserves special attention, since its fiber quality was lower than that of other groups. The question arises as to whether all or most 3.2 Micronaire cottons would react in processing like the 3.2 group of this study. In view of the tendency (discussed above) for low-Micronaire cottons to be low in both fiber length uniformity and fiber strength, it appears that cotton with Micronaire readings as low as 3.2 is likely to present some problems in processing. Possible exceptions may be found in high-strength or genetically fine varieties, in which the higher strength and/or more mature fibers would minimize the kind of fiber breakage occurring in processing which was evident in this study.

Spinning Quality

Natural Mixes

Spinning quality is defined to include both processing performance and yarn quality. Table 4 shows the various processing properties--constituting spinning quality--for each of the natural Micronaire mixes.

Table 4.--Cotton: Selected processing properties, by natural Micronaire group, 1968-69 crop

Spindle speed	Natural Micronaire level				
	3.2	3.7	4.2	4.7	5.2
	Neps/100 Sq. In. Card Web (Number)				
1/	11	4	4	3	3
	Total Picker and Card Waste (Percent)				
1/	5.58	5.35	4.98	5.25	5.22
	Corrected EDMSH 2/ (Number)				
12,000	92	19	22	35	94
12,500	170	38	43	80	3/ 28
13,000	4/ 45	52	82	200	4/ 51
	Break Factor (Units)				
12,000	1,860	2,054	1,972	1,908	1,816
12,500	1,841	2,075	1,937	1,945	3/ 1,894
13,000	4/ 1,890	2,012	1,929	1,850	4/ 1,914
	Yarn Appearance (Index)				
12,000	62	80	84	94	94
12,500	67	88	88	93	3/ 89
13,000	4/ 63	84	86	94	4/ 90
	Yarn Irregularity, C.V. (Percent)				
12,000	24.0	22.2	22.0	22.3	22.4
12,500	24.0	21.9	22.1	22.6	3/ 22.4
13,000	4/ 24.2	21.9	22.1	22.4	4/ 22.0
	Neps/1,000 Yards Yarn (Number)				
12,000	1,280	851	850	846	827
12,500	1,350	812	820	808	3/ 782
13,000	4/ 1,452	776	803	862	4/ 798

1/ Not applicable. 2/ EDMSH is ends down per thousand spindle hours.
3/ Spun at 11,000 r.p.m. spindle speed because of high end breakage at 12,500 r.p.m.
4/ Spun at 11,500 r.p.m. spindle speed because of high end breakage at 13,000 r.p.m.

Total picker and card waste and nep count at the card were higher in the 3.2 group than in any other.

The two discount Micronaire groups, 3.2 and 5.2, had much higher levels of spinning end breakage than the other groups. In fact, neither could be spun at 13,000 r.p.m. spindle speed. The best spinning lot was the 3.7 group. It had a lower average spinning end breakage than either the 4.2 or 4.7 groups at all speeds, with a particularly marked difference at 13,000 r.p.m. spindle speed.

The 3.7 Micronaire group also had the highest break factor. Apparently, the lower fiber strength and shorter fiber length of the 3.2 Micronaire group reduced its break factor level; whereas, the extremely coarse fibers of the 5.2 group overshadowed its higher fiber strength to reduce its break factor.

Yarn appearance improved as Micronaire levels increased through 4.7, with no improvement in the 5.2 group. Yarn irregularity C.V. and neps per 1,000 yards of yarn were about constant, except for the high levels in the 3.2 Micronaire group.

The foregoing results are to be expected when spinning 40s carded yarn from natural mixes of the type included in this study. They provide a background against which the results of the following section are discussed.

Blended Mixes

Blended mixes were observed at three levels of Micronaire--3.7, 4.2, and 4.7. Each level is discussed separately.

None of the 3.7 blends performed as well in any respect as the natural 3.7 mix when spun at the same spindle speeds (table 5). The best blends--mixes 6, 21, and 22--had about twice as many spinning end breaks, about 160 units less break factor, about seven units lower yarn appearance, and about 400 more neps per 1,000 yards of yarn than the natural 3.7 mix. Since the natural 3.7 group was the best performing natural group, its performance was reduced when it was blended with cotton from any other group. All blends averaging 3.7 Micronaire contained some 3.2 natural Micronaire cotton. However, no mill-type mix, in which very small percentages of the discount cottons are used, was spun in the 3.7 Micronaire group.

In the 4.2 Micronaire group of blends, several blended mixes performed well (table 6). Mix 13--a blend of 59 percent 3.7 Micronaire cotton and 41 percent 5.2 Micronaire--had significantly fewer spinning end breaks, higher break factor, and lower nep count in yarn than the natural 4.2 Micronaire group. Although no low-Micronaire cotton was included in this mix, 41 percent is a sizable proportion of the discount high-Micronaire cotton. The 4.2 Micronaire processing results show little evidence to indicate any detrimental effects of using 5.2 Micronaire cotton in the mix. However, use of as much as 25 percent 3.2 Micronaire cotton in a mix seriously affected performance. Use of 15 percent 3.2 Micronaire cotton in mix 16 produced results comparable with that of the natural 4.2 mix, except for a lower yarn appearance. Use of only 5 percent 3.2 Micronaire cotton produced results similar to that of the natural 4.2 mix.

Table 5.--Cotton: Selected processing properties, by blended Micronaire mix, and levels of statistical significance among 3.7 Micronaire mixes, averages of three reps, 1968-69 crop 1/

Mix No.	Micronaire content	Corrected EDMSH	Break factor	Yarn appearance	Yarn irreg.C.V.	Neps/1,000 yards
	Reading	Number	Units	Index	Percent	Number
2.....	3.7	36 c	2,047 a	84 a	22.0 d	813 d
6 2/..	3.2 & 4.2	74 b	1,891 bc	77 b	22.9 c	1,183 c
7.....	3.2 & 4.7	85 ab	1,860 d	75 bc	23.4 a	1,385 a
8.....	3.2 & 5.2	107 a	1,862 cd	75 bc	23.0 bc	1,277 b
19....	3.2, 4.2, & 4.7	86 ab	1,893 b	73 c	23.0 bc	1,178 c
21....	3.2, 4.2, & 4.7	85 ab	1,888 bcd	76 bc	23.0 bc	1,191 c
22....	3.2, 4.2, & 4.7	82 b	1,885 bcd	78 b	23.2 ab	1,206 c

1/ Averages within any column followed by the same letter are not significantly different at the 90 percent level. Averages not followed by the same letter are different at or beyond the 90 percent level. The three reps were spun at three different spindle speeds.

2/ Based on average of two reps.

Table 6.--Cotton: Selected processing properties, by blended Micronaire mix, and levels of statistical significance among 4.2 Micronaire mixes, averages of three reps, 1968-69 crop 1/

Mix No.	Micronaire content	Corrected EDMSH	Break factor	Yarn appearance	Yarn irreg.C.V.	Neps/1,000 yards
	Reading	Number	Units	Index	Percent	Number
3.....	4.2	49 c	1,946 b	86 bc	22.1 cde	824 e
10....	3.2 & 4.7	72 b	1,911 c	83 cd	21.9 de	971 b
11 2/..	3.2 & 5.2	87 a	1,835 d	83 cd	22.9 a	1,094 a
12....	3.7 & 4.7	59 bc	1,919 bc	84 cd	22.0 cde	854 de
13 2/..	3.7 & 5.2	32 d	2,014 a	85 bcd	21.8 e	761 f
16....	3.2, 3.7, & 4.7	51 c	1,950 b	82 d	22.4 b	919 c
17....	3.7, 4.7, & 5.2	46 c	1,984 a	91 a	22.3 bc	887 cd
20....	3.2, 3.7, 4.2, 4.7, & 5.2	45 c	1,944 b	85 bcd	22.2 bcd	884 cd
23....	3.7, 4.7, & 5.2	48 c	1,987 a	88 ab	22.1 cde	707 c

1/ Averages within any column followed by the same letter are not significantly different at the 90 percent level. Averages not followed by the same letter are different at or beyond the 90 percent level. The three reps were spun at three different spindle speeds.

2/ Based on average of two reps.

Within the group of 4.7 Micronaire blends, almost all blended mixes performed better than the natural 4.7 mix (table 7). The only exception was mix 9, which contained only discount cottons--17 percent 3.2 and 83 percent 5.2 Micronaire cottons. Generally, these blends and the natural mix performed unsatisfactorily when compared with mixes of a lower average Micronaire reading.

Table 7.--Cotton: Selected processing properties, by blended Micronaire mix, and levels of statistical significance among 4.7 Micronaire mixes, averages of three reps, 1968-69 crop 1/

Mix No.	Micronaire content	Corrected EDMSH	Break factor	Yarn appearance	Yarn irreg.C.V.	Neps/1,000 yards
	Reading	Number	Units	Index	Percent	Number
4.....	4.7	105 ab	1,901 ab	94 a	22.4 a	839 b
9 2/..	3.2 & 5.2	113 a	1,867 b	85 b	22.2 a	925 a
14 2/.	3.7 & 5.2	88 abc	1,875 ab	90 ab	22.3 a	847 b
15....	4.2 & 5.2	67 c	1,904 ab	91 a	22.2 a	787 c
18....	3.7, 4.2, & 5.2	77 bc	1,913 a	92 a	22.2 a	844 b

1/ Averages within any column followed by the same letter are not significantly different at the 90 percent level. Averages not followed by the same letter are different at or beyond the 90 percent level. The three reps were spun at three different spindle speeds.
2/ Based on average of two reps.

Dyeing Quality

Dyeing quality was determined by qualitative appearance after dyeing fabric that contained the test yarns as filling in a filling-face sateen.

Among the natural Micronaire groups, increasing the Micronaire level tended to yield darker dyeings, as follows:

Mix No.	Micronaire level	Dyeing appearance
1	3.2	Very light
2	3.7	Light
3	4.2	Light
4	4.7	Dark
5	5.2	Dark

Among the mixes with 3.7 Micronaire readings, the natural Micronaire mix was darkest and the best solid shade. All others were lighter and similar to each other in appearance. These results reflect the relatively high percentages of the 3.2 Micronaire cotton in these mixes.

Within the 4.2 Micronaire group, several of the blended mixes were equal in appearance to the natural 4.2 mix. Sizable quantities of 4.7 and/or 5.2 Micronaire cotton were included in some of the mixes in this group (table 1).

Mixes 11, 20, and possibly 23 were slightly lighter than the other mixes. Again, sizable proportions of 3.2 and/or 3.7 Micronaire cottons in these mixes probably account for the differences. However, mixes with up to 25 percent 3.2 or 60 percent 3.7 failed to show any difference.

Within the 4.7 Micronaire group, the natural Micronaire mix was darkest and the best solid shade. All other mixes, containing varying amounts of lower Micronaire cottons, were lighter and similar to each other in appearance.

Results of the dyeing tests in which dye concentrations were varied until dyed yarn from each natural Micronaire level (3.2, 3.7, 4.7, and 5.2) matched dyed yarn from the 4.2 Micronaire level are shown in table 8.

Table 8.--Cotton: Dye concentrations required to match the shade of yarn from the natural 4.2 Micronaire group, mixes 1 through 5, 1968-69 crop

Dye	Mix No.	Micronaire level	Dye concentration to match shade 1/	Change in dye concentration
		Reading	Percent	Percent
C.I. Direct Blue 1.....	1	3.2	2.5	+25
Do.....	2	3.7	2.2	+10
Do.....	3	4.2	2.0	--
Do.....	4	4.7	1.8	-10
Do.....	5	5.2	1.7	-15
C.I. Direct Red 81.....	1	3.2	3.5	+75
Do.....	2	3.7	2.2	+10
Do.....	3	4.2	2.0	--
Do.....	4	4.7	1.9	-5
Do.....	5	5.2	1.5	-25

1/ Dye concentration percentages are based on yarn weight.

Under normal conditions of dyeing time and temperature, the lower Micronaire cottons require more dye and the higher Micronaire cottons less dye to match the shade of the median Micronaire (4.2) cotton. The relative differences in amount of dye required to match shades are greater for C.I. Direct Red 81 than for C.I. Direct Blue 1. This is caused primarily by the relatively poorer affinity of the red dye for the thin-walled fibers in the lower Micronaire cottons.

After a single mild washing, the red-dyed samples revert to the original dyeing pattern; that is, the lower the Micronaire reading, the lighter the shade and the poorer the general appearance. The blue-dyed samples also change to some extent after mild washing. The 3.7, 4.2, and 4.7 Micronaire samples still match; but compared with the 4.2 Micronaire sample, the 3.2 Micronaire sample is lighter and the 5.2 sample is darker. Thus, although shades can be matched among Micronaire levels by altering dyeing procedures, the fastness properties--and hence dyeing qualities--are related to Micronaire reading.

Wet-processing weight losses decreased significantly as Micronaire readings increased. This same trend was noted in previous Micronaire studies. Results were as follows:

Mix No.	Micronaire level	Wet-processing weight loss (percent)
1	3.2	8.7
2	3.7	7.5
3	4.2	6.4
4	4.7	6.0
5	5.2	5.5

Blending Efficiency

Blending efficiency, tested by measuring alcohol extractables, was very good. In no case was there an indication that any large errors in blending occurred. The results are shown in table 9.

Table 9.--Cotton: Comparison of actual alcohol extractables and extractables predicted on the basis of a perfect blend, by blended mix, 1968-69 crop

Mix No.	Predicted from raw stock	Actual in drawing sliver
	Percent	Percent
6	2.09	2.08
7	2.24	2.23
8	2.21	2.12
9	1.73	1.65
10	2.00	1.89
11	1.94	1.91
12	2.00	2.00
13	1.97	1.85
14	1.74	1.70
15	1.64	1.60
16	2.00	1.94
17	1.98	1.93
18	1.69	1.67
19	2.21	2.17
20	1.87	1.86
21	2.17	2.15
22	2.14	2.14
23	1.99	1.94

Economics of Blending Discount Cottons

Raw cotton price discounts and relative performance of the various mixes in the 3.7, 4.2, and 4.7 Micronaire groups are shown in table 10. A mix was designated as unsatisfactory (U) when compared with a natural mix unless all five processing properties (corrected ends down, yarn break factor, yarn appearance, yarn irregularity, and neps/1,000 yards of yarn) were equal to or better than those of the natural mix. This requirement is very strict (see appendix tables 2-4 for comparison of individual properties). Most entries in the last column are "unsatisfactory" because of low yarn appearance, compared with the natural 4.7 Micronaire mix. The natural mixes of 3.2 and 5.2 Micronaire cotton were not included in this comparison since processing results were not satisfactory, and there were no corresponding blends with which to compare them.

When compared with the natural 3.7 mix, only one mix--number 13--was satisfactory in overall performance. This mix is a blend of 59 percent 3.7 and 41 percent 5.2 Micronaire cotton at a discount of 0.26 per pound. Although several mixes containing 3.2 Micronaire cotton were discounted considerably, none was entirely satisfactory in overall performance in comparison with the natural 3.7 Micronaire mix. Note that the 3.7 mix has already been indicated as the best spinning natural Micronaire mix.

Several mixes containing discount cotton performed as well overall as the natural 4.2 Micronaire mix. All 4.2 mixes, except numbers 10 and 11, performed as well as the natural 4.2 mix in terms of spinning end breakage and break factor. Mix 13, discussed above, obviously was satisfactory. In addition, mix 12 was satisfactory in performance but contained no discount cotton. Mixes 17, 20, and 23, which approach the type of mixes currently used in mills (with relatively low levels of discount cottons), were satisfactory in performance when compared with the 4.2 natural Micronaire mix. One contained 27 percent 5.2 Micronaire cotton and none of 3.2; one contained 9 percent 5.2 Micronaire cotton and 5 percent 3.2; and the other contained 13 percent 5.2 Micronaire cotton and none of 3.2. Their prices were discounted 0.17, 0.19, and 0.08 cent per pound, respectively.

Only one blended mix outside the 4.7 Micronaire group spun as well in all respects as the natural 4.7 mix. Primarily, this failure was the result of significantly lower yarn appearance among blends of lower average Micronaire value. Within the 4.7 Micronaire group, however, each blend--except the one containing a percentage of 3.2 Micronaire cotton--performed at least as well overall as did the natural 4.7 Micronaire mix. There was a strong tendency within this group for the blends to spin at a lower level of end breakage than that of the natural mix.

More detailed data concerning price discounts and relative processing results by mix for individual processing properties are given in Appendix tables 2 through 4.

Dyeing results tended to confirm the foregoing results observed through spinning. Mix 13 was satisfactory in dyeing quality, as was mix 17, which contained no 3.2 Micronaire cotton. Mix 20, with 5 percent 3.2 and 9 percent

Table 10.--Cotton: Price discounts and relative performance, by mix, for 3.7, 4.2, and 4.7 Micronaire groups, 1968-69 crop

Mix No.	Micronaire content	Discount 1/	Performance compared with that of natural Micronaire group 2/		
			3.7	4.2	4.7
	Reading	Cents/pound	Rating		
		3.7 Micronaire Group			
2	3.7	None	S	S	U
6	3.2 & 4.2	1.12	U	U	U
7	3.2 & 4.7	1.51	U	U	U
8	3.2 & 5.2	1.91	U	U	U
19	3.2, 4.2, & 4.7	1.40	U	U	U
21	3.2, 4.2, & 4.7	1.33	U	U	U
22	3.2, 4.2, & 4.7	1.25	U	U	U
		4.2 Micronaire Group			
3	4.2	None	U	S	U
10	3.2 & 4.7	0.65	U	U	U
11	3.2 & 5.2	1.38	U	U	U
12	3.7 & 4.7	None	U	S	U
13	3.7 & 5.2	.26	S	S	U
16	3.2, 3.7, & 4.7	.34	U	U	U
17	3.7, 4.7, & 5.2	.17	U	S	S
20	3.2, 3.7, 4.2, 4.7, & 5.2	.19	U	S	U
23	3.7, 4.7, & 5.2	.08	U	S	U
		4.7 Micronaire Group			
4	4.7	None	U	U	S
9	3.2 & 5.2	0.96	U	U	U
14	3.7 & 5.2	.47	U	U	S
15	4.2 & 5.2	.35	U	U	S
18	3.7, 4.2, & 5.2	.41	U	U	S

1/ The average discount for Micronaire in all markets for the 1968-69 crop year was applied to the percentages of discount Micronaire cotton in each mix to arrive at the above discounts. See U.S. Department of Agriculture, Consumer and Marketing Service, Cotton Price Statistics, Vol. 50, No. 13, September 1969, p. 22.

2/ Considers all spinning quality factors. S is satisfactory; U is unsatisfactory. See Appendix tables for comparison of individual spinning quality factors.

5.2 Micronaire, showed a slight tendency to dye lighter than other mixes averaging 4.2 Micronaire.

Useful information was obtained on the effects of varying the spindle speed during processing. The nature of spindle speed effects on spinning quality of the natural mixes was indicated in table 4. The impressive effects are the increase in spinning end breakage resulting from greater spindle speed and a significant drop in break factor due to increased spindle speeds (table 11.) None of the other spinning quality factors were significantly affected by greater spindle speed.

Table 11.--Cotton: Estimated effects of Micronaire reading and spindle speed on EDMSH and break factor, averaged across both natural and blended mixes, 1968-69 crop

Spindle speed	3.7 Micronaire		4.2 Micronaire		4.7 Micronaire	
	EDMSH	Break factor	EDMSH	Break factor	EDMSH	Break factor
	Number	Units	Number	Units	Number	Units
12,000	40	1,914	29	1,971	41	1,915
12,500	74	1,915	51	1,950	75	1,909
13,000	124	1,882	84	1,909	154	1,857

More detailed data concerning the effects of spindle speed are given in Appendix table 5. These data were used as a basis for estimating the reductions in spindle speed required to decrease spinning end breakage to the level of the natural 3.7 or 4.2 Micronaire group spun at 12,000 r.p.m. spindle speed. At this production rate, both the 3.7 and 4.2 natural groups spun at about 20 ends down (table 4). For mixes 1, 5, 7, 8, 9, 14, and 19--all containing substantial amounts of discount cottons--an adjusted spindle speed was estimated from the slopes of ends down on spindle speed available for these mixes. The estimated decrease in spindle speed necessary to reduce end breakage to a level of 20 (the approximate level of the 3.7 and 4.2 natural mixes) is shown in table 12. Also shown are break factor and yarn appearance for each mix. The yarn appearance was not adjusted for differences in spindle speed, since the effect was not significant.

To demonstrate how the estimates and data in table 12 might be used to determine appropriate price discounts for a given purchaser, the following assumptions were made:

Manufacturing waste	= 10 percent
Yarn price	= 60 cents per pound
Profit	= 5 percent of gross sales
Break factor worth	= ½ cent per 100 units
Yarn appearance worth	= ½ cent per 10 units
Total manufacturing cost	= 25 cents per pound

Variable cost	= 10 cents per pound 3/
Fixed cost	= 15 cents per pound

Assuming that the variable manufacturing costs truly change with production rate, only the fixed costs per pound increase with reduced spindle speed. Also, assuming that all production can be sold or used at 60 cents per pound, the proportion of profit foregone by speed reductions is also charged against each cotton in calculating the discount.

Table 12.--Cotton: Estimated reduction in spindle speed required to obtain 20 EDMSH, estimated break factor at the reduced spindle speed, and yarn appearance at 12,000 r.p.m. spindle speed, selected mixes, 1968-69 crop

Mix No.	Average Micronaire	Micronaire content	EDMSH at 12,000 r.p.m.	Reduction in spindle speed: to obtain 20 EDMSH		Break factor 1/	Yarn appearance
	Reading	Reading	Number	R.p.m.	Pct.	Units	Index
3 2/	4.2	4.2	22	0	0	1,972	84
1	3.2	3.2	92	1,150	9.6	1,918	62
4	4.7	4.7	35	320	2.7	1,927	94
5	5.2	5.2	94	1,280	10.7	1,916	94
6	3.7	3.2 & 4.2	40	620	5.2	1,962	79
7	3.7	3.2 & 4.7	36	475	4.0	1,881	76
8	3.7	3.2 & 5.2	50	750	6.2	1,899	72
9	4.7	3.2 & 5.2	59	875	7.3	1,922	81
11	4.2	3.2 & 5.2	49	706	5.9	1,907	83
13	4.2	3.7 & 5.2	3/20	0	0	2,104	87
14	4.7	3.7 & 5.2	41	755	6.3	1,985	88
19	3.7	3.2, 4.2, & 4.7	41	585	4.9	1,935	74

1/ Estimated for the reduced spindle speed calculated to produce 20 EDMSH.
2/ Base.
3/ Not spun at 12,000 r.p.m. Interpolation of results at higher speeds indicates that ends down would be 20 or less at 12,000 r.p.m.

The effective selling price of a pound of cotton in the form of yarn, adjusted for waste, is (0.9) (60 cents) = 54 cents per pound (ignoring any resale value of waste). Then the profit per pound of raw cotton is 2.7 cents = (54 cents) (0.05). Thus, a 10-percent reduction in production rate results in a 0.27-cent reduction in profit per pound of raw cotton, since more time is required to process it into yarn.

3/ Assumes that only spinner labor varies with rate of production and that 60 percent of repairs and supplies; 20 percent of power; 50 percent of supervision, fringe benefits, and overtime; and zero percent of depreciation and general overhead varies with rate of production.

Taking mix number 1 as an example, the profit foregone is 0.26 cent per pound of raw cotton, that is, 0.096 x 217 cents. The estimated 9.6 percent reduction in spindle speed also increases unit fixed cost to 16.59 cents per pound of yarn, that is, 15 cents fixed cost ÷ 1.00-0.096. This is an increase of 1.59 cents per pound of yarn. Next, the increase of 1.59 cents is multiplied by 0.9 to give 1.43 cents increase per pound of raw cotton. Combining these two estimates yields an estimated loss of 1.69 cents per pound of raw cotton due to the reduced production rate. A further discount of 0.24 cents--(0.9) (0.54) (½ cent)--is applied because of the 54 units lower break factor relative to the base mix.

Finally, an added discount of 0.99 cent--(0.9) (2.2) (½ cent)--is applied because of the 2.2 units lower yarn appearance. Thus, the total estimated discount for mix number 1 is 2.92 cents per pound, that is, 1.69 + 0.24 + 0.99.

These estimated discounts were calculated for selected mixes and are shown in table 13. Given the foregoing assumptions and the processing results of these mixes, the estimated price discounts appear to be generally in line with 1969 market price discounts for the blended mixes. Spinning either low (3.2) or high (5.2) Micronaire alone yields estimated discounts which are greater than market discounts, indicating that spinning of pure types is not economical.

Table 13.--Cotton: Estimates of Micronaire price discounts for a hypothetical processing situation, compared with market discounts, selected mixes, 1968-69 crop

Mix No.	Average Micronaire	Micronaire content	Estimated discount for: Production rate	Break factor	Yarn App.	Total	Market price discount 1/
	Reading	Reading	Cents per pound				
3 2/...	4.2	4.2	0	0	0	0	0
1.....	3.2	3.2	1.69	0.24	0.99	2.92	2.60
4.....	4.7	4.7	.45	.20	-.45	.20	0
5.....	5.2	5.2	1.91	.25	-.45	1.71	.63
6.....	3.7	3.2 & 4.2	.88	.04	.04	.96	1.12
7.....	3.7	3.2 & 4.7	.67	.41	.36	1.44	1.51
8.....	3.7	3.2 & 5.2	1.06	.33	.54	1.93	1.91
9.....	4.7	3.2 & 5.2	1.26	.22	.14	1.62	.96
11.....	4.2	3.2 & 5.2	1.01	.29	.04	1.34	1.38
13.....	4.2	3.7 & 5.2	0	-.59	-.14	-.73	.26
14.....	4.7	3.7 & 5.2	1.08	-.06	-.18	.84	.47
19.....	3.7	3.2, 4.2, & 4.7	.82	.17	.45	1.44	1.40

1/ U.S. Department of Agriculture, Consumer and Marketing Service, Cotton Price Statistics, Vol. 50, No. 13, September 1969, p. 22.
2/ Base.

These results show that blending of discount cottons with cottons in the mid-range of Micronaire readings appears to be economically feasible, although there is a tendency for the price advantage to the manufacturer to be offset by lower processing performance.

The primary purpose of the estimated price discounts is to demonstrate a method of calculations, since costs and product values vary from one mill to another. A further limitation of these results is the use of a 3.54 twist multiplier, which is lower than that normally used for 40s yarn.

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Appendix table 1.--Cotton: Selected properties of individual bales before preblending, 1968-69 crop

Micronaire content	2.5 percent span	Length uniformity	Pressley	Sugar	Maturity: Causti-caire	Maturity: Differential dyeing 1/
Reading	Inches	Ratio	1,000 p.s.i.	Percent	Index	Rating
			3.2 Micronaire Group			
3.4	1.13	44	90	0.12	67	Mature
3.4	1.12	45	90	.22	68	Do.
3.2	1.13	43	86	.37	66	Immature
3.1	1.10	43	74	.46	66	Do.
3.2	1.12	44	73	.50	66	Do.
3.2	1.09	43	74	.48	65	Do.
3.3	1.10	43	73	.34	66	Intermediate
3.2	1.11	43	73	.47	63	Immature
3.3	1.12	43	74	.50	64	Do.
			3.7 Micronaire Group			
4.1	1.12	47	88	0.26	73	Mature
3.8	1.09	47	85	.19	71	Immature
3.8	1.10	47	84	.19	69	Mature
3.8	1.12	45	85	.38	70	Immature
3.6	1.12	44	80	.20	70	Do.
3.5	1.10	45	82	.35	72	Do.
3.6	1.15	47	80	.32	69	Mature
			4.2 Micronaire Group			
4.3	1.12	45	79	0.10	76	Mature
4.2	1.10	46	84	.25	76	Intermediate
4.1	1.13	46	87	.27	76	Immature
4.0	1.11	46	86	.32	75	Do.
4.2	1.11	46	82	.21	75	Intermediate
4.3	1.12	49	82	.08	76	Do.
			4.7 Micronaire Group			
4.6	1.12	47	87	0.19	78	Intermediate
4.9	1.08	46	88	.11	80	Mature
4.7	1.11	47	86	.22	79	Immature
4.6	1.10	47	83	.20	78	Intermediate
4.8	1.11	48	90	.40	79	Do.
4.9	1.11	47	98	.32	79	Mature
4.8	1.14	47	96	.57	78	Intermediate
5.0	1.10	47	92	.47	80	Immature
4.7	1.09	46	88	.18	78	Mature
			5.2 Micronaire Group			
5.3	1.12	48	87	0.13	80	Mature
5.2	1.09	48	86	.12	80	Do.
5.2	1.09	48	85	.12	80	Do.
5.1	1.09	46	87	.07	79	Do.
5.2	1.11	48	97	.47	82	Intermediate
5.2	1.11	47	99	.36	80	Immature
5.2	1.09	47	95	.37	80	Do.
5.3	1.11	47	99	.53	81	Do.
5.4	1.12	48	93	.39	82	Do.
4.9	1.09	46	79	.09	80	Do.

1/ Comparisons are within each Micronaire group only.

Appendix table 2.--Cotton: Price discounts and relative end breakage, by mix, for 3.7, 4.2, and 4.7 Micronaire groups, 1968-69 crop

Mix No.	Micronaire content	Price discount 1/	End breakage compared with that of natural Micronaire group:		
			3.7	4.2	4.7
	Reading	Cents/lb.	Rating 2/		
		3.7 Micronaire Group			
2	3.7	None	S	S	S
6	3.2 & 4.2	1.12	U	U	S
7	3.2 & 4.7	1.51	U	U	S
8	3.2 & 5.2	1.91	U	U	S
19	3.2, 4.2, & 4.7	1.40	U	U	S
21	3.2, 4.2, & 4.7	1.33	U	U	S
22	3.2, 4.2, & 4.7	1.25	U	U	S
		4.2 Micronaire Group			
3	4.2	None	U	S	S
10	4.2 & 4.7	0.65	U	U	S
11	3.2 & 5.2	1.38	U	U	S
12	3.7 & 4.7	None	U	S	S
13	3.7 & 5.2	.26	S	S	S
16	3.2, 3.7, & 4.7	.34	U	S	S
17	3.7, 4.7, & 5.2	.17	U	S	S
20	3.2, 3.7, 4.2, 4.7, 5.2	.19	U	S	S.
23	3.7, 4.7, & 5.2	.08	U	S	S
		4.7 Micronaire Group			
4	4.7	None	U	U	S
9	3.2 & 5.2	0.96	U	U	S
14	3.7 & 5.2	.47	U	U	S
15	4.2 & 5.2	.35	U	U	S
18	3.7, 4.2, & 4.7	.41	U	U	S

1/ U.S. Department of Agriculture, Consumer and Marketing Service, Cotton Price Statistics, Vol. 50, No. 13, September 1969, p. 22.
2/ S is satisfactory; U is unsatisfactory.

Appendix table 3.--Cotton: Price discounts and relative break factor, by mix, for 3.7, 4.2, and 4.7 Micronaire groups, 1968-69 crop

Mix No.	Micronaire content	Price discount 1/	Break factor compared with that of natural Micronaire group: 3.7	4.2	4.7
	Reading	Cents/lb.	Rating 2/		
		3.7 Micronaire Group			
2	3.7	None	S	S	S
6	3.2 & 4.2	1.12	U	U	S
7	3.2 & 4.7	1.51	U	U	U
8	3.2 & 5.2	1.91	U	U	U
19	3.2, 4.2, & 4.7	1.40	U	U	S
21	3.2, 4.2, & 4.7	1.33	U	U	S
22	3.2, 4.2, & 4.7	1.25	U	U	S
		4.2 Micronaire Group			
3	4.2	None	U	S	S
10	4.2 & 4.7	0.65	U	U	S
11	3.2 & 5.2	1.38	U	U	U
12	3.7 & 4.7	None	U	S	S
13	3.7 & 5.2	.26	S	S	S
16	3.2, 3.7, & 4.7	.34	U	S	S
17	3.7, 4.7, & 5.2	.17	U	S	S
20	3.2, 3.7, 4.2, 4.7 & 5.2	.19	U	S	S
23	3.7, 4.7, & 5.2	.08	U	S	S
		4.7 Micronaire Group			
4	4.7	None	U	U	S
9	3.2 & 5.2	0.96	U	U	S
14	3.7 & 5.2	.47	U	U	S
15	4.2 & 5.2	.35	U	U	S
18	3.7, 4.2, & 4.7	.41	U	S	S

1/ U.S. Department of Agriculture, Consumer and Marketing Service, Cotton Price Statistics, Vol. 50, No. 13, September 1969, p. 22.
2/ S is satisfactory; U is unsatisfactory.

Appendix table 4.--Cotton: Price discounts and relative yarn appearance, by mix, for 3.7, 4.2, and 4.7 Micronaire groups, 1968-69 crop

Mix No.	Micronaire content	Price discount 1/	Yarn appearance compared with that of natural Micr. group: 3.7	4.2	4.7
	Reading	Cents/lb.	Rating 2/		
		3.7 Micronaire Group			
	3.7	None	S	S	U
	3.2 & 4.2	1.12	S	U	U
	3.2 & 4.7	1.51	S	U	U
	3.2 & 5.2	1.91	S	U	U
	3.2, 4.2, & 4.7	1.40	S	U	U
	3.2, 4.2, & 4.7	1.33	S	U	U
	3.2, 4.2, & 4.7	1.25	S	U	U
		4.2 Micronaire Group			
	4.2	None	S	S	U
	3.2 & 4.7	0.654	S	S	U
	3.2 & 5.2	1.38	S	S	U
	3.7 & 4.7	None	S	S	U
	3.7 & 5.2	.26	S	S	U
	3.2, 3.7, & 4.7	.34	S	U	U
	3.7, 4.7, & 5.2	.17	S	S	S
	3.2, 3.7, 4.2, 4.7, & 5.2	.19	S	S	U
	3.7, 4.7, & 5.2	.08	S	S	U
		4.7 Micronaire Group			
	4.7	None	S	S	S
	3.2 & 5.2	0.96	S	S	U
	3.7 & 5.2	.47	S	S	S
	4.2 & 5.2	.35	S	S	S
	3.7, 4.2, & 4.7	.41	S	S	S

/ U.S. Department of Agriculture, Consumer and Marketing Service, Cotton
ce Statistics, Vol. 50, No. 13, September 1969, p. 22.
/ S is satisfactory; U is unsatisfactory.

Appendix table 5.--Cotton: Corrected ends down and break factor by lot and spindle speed, 1968-69 crop

Mix No.	Corrected EDMSH of--			Break factor of--		
	12,000 r.p.m.	12,500 r.p.m.	13,000 r.p.m.	12,000 r.p.m.	12,500 r.p.m.	13,000 r.p.m.
	Number			Units		
1	92	170	1/ 45	1,860	1,841	1/ 1,890
2	19	38	52	2,054	2,075	2,012
3	22	43	82	1,972	1,937	1,929
4	35	80	200	1,908	1,945	1,850
5	94	2/ 28	1/ 51	1,816	2/ 1,894	1/ 1,914
6	40	64	1/ 21	1,924	1,880	1/ 1,942
7	36	94	124	1,872	1,855	1,854
8	50	100	170	1,869	1,890	1,828
9	59	103	1/ 30	1,884	1,883	1/ 1,928
10	38	67	110	1,918	1,924	1,890
11	49	96	1/ 27	1,868	1,834	1/ 1,890
12	27	53	97	1,960	1,918	1,880
13	3/ 44	26	60	3/ 1,965	2,034	1,966
14	41	70	1/ 27	1,929	1,856	1/ 1,929
15	30	52	120	1,927	1,922	1,864
16	26	46	82	1,960	1,960	1,929
17	27	42	70	2,016	2,020	1,917
18	42	68	122	1,926	1,916	1,897
19	41	78	140	1,905	1,922	1,853
20	29	48	59	1,973	1,932	1,928
21	48	70	136	1,880	1,903	1,882
22	48	74	125	1,895	1,883	1,876
23	31	37	76	2,029	1,993	1,938

1/ Spun at 11,500 spindle speed because of high end breakage at 13,000 r.p.m.
2/ Spun at 11,000 spindle speed because of high end breakage at 12,500 r.p.m.
3/ Spun at 12,750 spindle speed because of low end breakage at 12,000 r.p.m.